GREENHECK
Building Value in Air.

Document 479830
Vari-Green Constant Volume Controller for AMD and AMS Series

Installation, Operation and Maintenance Manual

Please read and save these instructions for future reference. Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with these instructions will result in voiding of the product warranty and may result in personal injury and/or property damage.

These instructions apply to Greenheck's Vari-Green Constant Volume damper controller. The controller accepts an analog output from a factory supplied pressure transducer on a Greenheck AMS airflow measuring station or AMD airflow measuring damper to calculate the real-time volumetric airflow rate (cfm) going through the unit. Using PID logic the controller then controls the damper's actuator to achieve a target cfm setpoint. The cfm setpoint can be established either remotely via an analog input to the controller or locally using touch sensitive buttons on the cover of the controller.

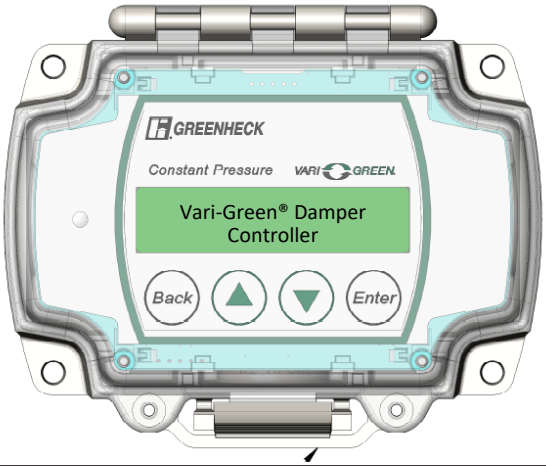


Table of Contents

STORAGE

Controls are protected against damage during shipment. If the control cannot be installed and operated immediately, precautions need to be taken to prevent deterioration of the control during storage. The user assumes responsibility of the control and any accessories while in storage. The manufacturer will not be responsible for damage during storage. These suggestions are provided solely as a convenience to the user.

The ideal environment for the storage of controls is indoors, above grade, in a low humidity atmosphere which is sealed to prevent the entry of blowing dust, rain or snow. Temperatures should be evenly maintained between 30° to 110°F **(-1° to 43°C).** Wide temperature swings may cause condensation and "sweating" of metal parts. All accessories must be stored indoors in a clean, dry atmosphere.

REMOVING FROM STORAGE

As controls are removed from storage to be installed in their final location, they should be protected and maintained in a similar fashion until the control goes into operation. Environmental Operation Range: -4° to 140°F (-20 to 60°C).

RECEIVING

Upon receiving the control, check to ensure all items are accounted for by referencing the delivery receipt or packing list. Inspect each crate or carton for shipping damage before accepting delivery. Alert the carrier of any damage detected. The customer will make notification of damage (or shortage of items) on the delivery receipt and all copies of the bill of lading which is countersigned by the delivering carrier. If damaged, immediately contact your Greenheck Representative. Any physical damage to the unit after acceptance is not the responsibility of Greenheck Fan Corporation.

UNPACKING

Verify that all required parts and the correct quantity of each item have been received. If any items are missing, report shortages to your local representative to arrange for obtaining missing parts.

General Operation of the Controller

The Vari-Green Constant Volume Controller has two operating modes. The controller is factory set to its Flow Control Mode. In Flow Control Mode the controller will modulate the position of the damper to achieve a target airflow setpoint. The controller can also be put into Position Control Mode. In Position Control Mode the controller treats the setpoint as a target damper blade position.

In addition to the two operating modes the controller has a parameter called Setpoint Location that can be configured to either Remote or Local. The controller ships from the factory with the Setpoint Location set to Remote. In Remote mode the controller uses a voltage sent to one of its analog inputs to establish the setpoint (see the Setting the Flow Setpoint section below). When the Setpoint Location is in Local mode the interface on the front cover of the controller is used to establish the setpoint and the voltage sent to the analog input is ignored.

See the Field Configuration section of this document to learn how to change the Control Mode and Setpoint Location. The following section assumes that the controller is in the factory default Flow Control and Remote Setpoint Location modes.

Setting the Flow Setpoint

The controller accepts an analog input (configurable for either 0-10 or 2-10 VDC) that is proportional to a target volumetric airflow rate (cfm). The voltage corresponding to the setpoint can be determined using the following formulas:

0 - 10 VDC setpoint

$$C = Q / (V_{max} * A) * 10$$

2 - 10 VDC setpoint

$$C = Q / (V_{max} * A) * 8 + 2$$

Formula 1

Where:

C = Flow Setpoint (VDC)

Q = Desired Airflow (cfm)

V_{max} = Maximum Velocity as specified at the time the unit was ordered (fpm)

A = Face Area of the Damper (ft^2)

Airflow Output Signal

The controller outputs an analog signal (configurable for either 0-10 or 2-10 VDC) that is proportional to the real-time airflow rate (cfm) going through the AMD/AMS. The cfm corresponding to the voltage output can be determined using the following formulas:

0 - 10 VDC setpoint

$$Q = (C * V_{max} * A) / 10$$

2 - 10 VDC setpoint

$$Q = ((C - 2) * V_{max} * A) / 8$$

Formula 2

Where:

C = Voltage Output Signal (VDC)

Q = Real-time Airflow (cfm)

V max = Maximum Velocity as specified at the time the unit was ordered (fpm)

A = Face Area of the Damper (ft^2)

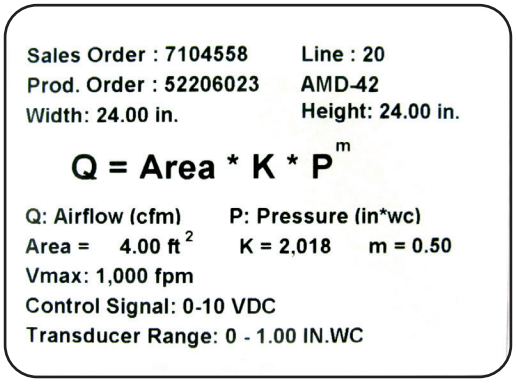


Figure 1 - Label affixed to AMS/AMD that lists the V_{max} and damper area.

Example: The BMS desires 2,000 cfm through a 24 in. x 24 in. AMD-42 that was ordered with a maximum velocity of 1,000 fpm. Find the voltage setpoint that corresponds to 2,000 cfm:

C = 2,000 / (1,000 * 4) * 10 = 5 VDC (0-10 VDC)

C = 2,000 / (1,000 * 4) * 8 +2 = 6 VDC (2-10 VDC)

Controller Display and Interface Buttons

There are four touch sensitive buttons on the controller's cover that are used to interface with the controller: Back, Enter, Up and Down (**see Figure 2**). The controller also has a two line backlit LCD display. By using the up and down arrows the display can be toggled through three sets of data:

- **Top Screen:** Real-Time CFM and CFM Setpoint
- **Middle Screen:** Real-Time Velocity (fpm) and Velocity Setpoint
- **Bottom Screen:** Real-Time Differential Pressure Measurement and Actuator Position

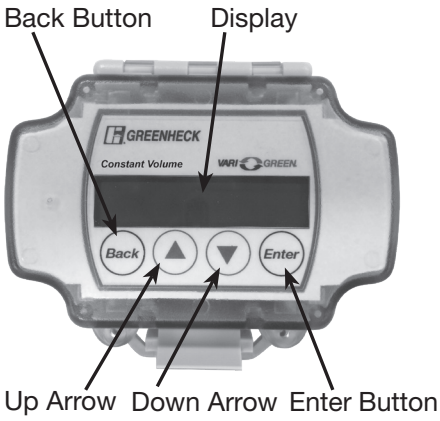


Figure 2 - Outside of the controller's cover

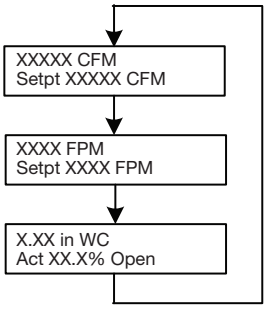


Figure 3 - Run Mode display screens

Controller Configuration

The Vari-Green Constant Volume Controller is shipped in "Run Mode". When calculating the airflow rate going through the AMS/AMD and to control the damper (on AMD models) the controller should be left in run mode. In most cases the controller should not need to be taken out of run mode. However, a variety of parameters can be adjusted in the field as needed by opening the controller's cover and moving the toggle switch into the PROG position (**see Figure 7**). Note: Putting the controller into PROG mode will cause the controller to close the actuator. Thus programming of the controller should not be done while the HVAC system is running.

When in program mode the display can be toggled through a "Top Level Menu" by using the up and down arrows on the controller's cover (**see Figure 4**). The desired menu item can be accessed by pressing the "Enter" button.

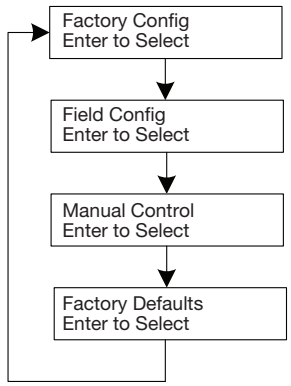


Figure 4 - Top level menu in Program Mode.

Factory Configuration

The controller comes from the factory configured with the physical parameters of the AMD/AMS it was ordered with. These parameters include:

- **Flow Measurement Device** – should always be left as “Diff Pressure”
- **The unit’s K & M Values** – damper specific constants used to calculate airflow. These values are set at the factory and can also be found on the label affixed to the AMD/AMS (**see Figure 1**)
- **Maximum Pressure** – this parameter represents the top-end of the AMD/AMS pressure transducer range. The selectable values are: 0.25” wc, 0.5” wc, 1.0” wc, 2.0” wc, 2.5” wc, 3.0” wc, and 5.0” wc. The maximum pressure is also a configurable value on the pressure transducer (see the transducer instructions). The top-end of the controller’s pressure range and the transducer’s pressure range must match for the controller to operate properly. They are set at the factory to the same values.
- **Damper Area** - the face area of the AMD/AMS (ft^2)
- **Maximum Velocity** – this parameter represents the velocity corresponding to a 10 VDC remote setpoint. This parameter is set by the factory to the value selected at the time the unit was ordered. The selectable values are: 500 fpm, 1000 fpm, 1500 fpm, 2000 fpm, 2500 fpm, 3000 fpm, 3500 fpm and 4000 fpm. To achieve optimal accuracy the lowest value that meets the application should be selected. Changing the maximum velocity value will affect the flow setpoint and flow output calculations. See formulas 1 and 2 on page 2.
- **Minimum Velocity** – this is the minimum velocity the unit is designed to accurately measure airflow and control the damper at. To avoid “hunting” the controller will treat setpoints below the minimum velocity as a setpoint of zero. The controller is set to a value of 300 fpm at the factory.

While the parameters in the factory configuration menu don’t normally require adjustment, they can be changed by putting the controller into Program Mode (see above) and then pressing enter on the “Factory Config” option in the top level menu. The factory configuration menu structure, **see Figure 5**, can be navigated by using the up and down arrows on the controller’s cover. When the parameter you wish to adjust is shown in the display press the "Enter" button to enter the edit mode. The parameter can then be adjusted by using the up and down arrows (parameter will blink on display when in edit mode). Once the desired value is selected press "Enter" again to leave edit mode. Once all of the parameters have been adjusted press the "Back" button on the controller to return to the top level menu or return the slider switch inside the controller to run mode.

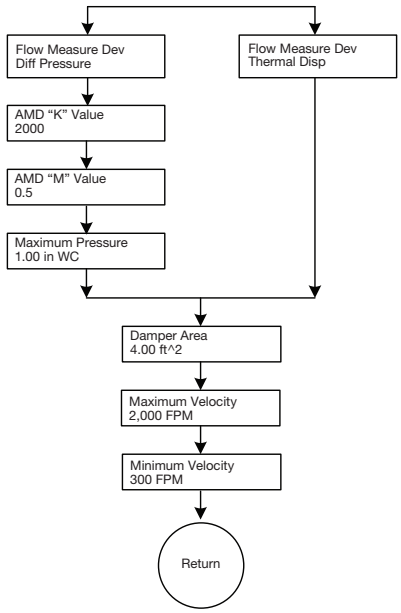


Figure 5 - Factory Configuration Menu Structure

Field Configuration

The controller comes from the factory with the parameters in the field configuration menu (**see Figure 6**) set to the most commonly used values. The field configuration menu can be accessed from the top level menu (**see Figure 4**).These parameters include:

- **Units of Measure** – the controller comes with imperial units selected. The controller can be configured to display in metric units.
- **Actuator Setpoint** – this parameter sets the type of analog output signal the controller will use to control the damper's actuator. The default selection is 2-10 VDC, but the controller can be configured to send a 0-10 VDC signal to the actuator.
- **Velocity Output** – this parameter sets the type of analog signal the controller uses to output the airflow rate. The default selection is 0-10 VDC, but the controller can be configured to output a 2-10 VDC signal.
- **Control Mode** – this parameter determines how the controller treats the setpoint. The default selection is Flow Control mode. In Flow Control mode the controller treats the setpoint as the desired airflow (cfm). See the section on Setting the Flow Setpoint. The controller can also be put into Position Control mode. In this mode the controller treats the setpoint as the desired position of the actuator.
- **Setpoint Location** – this parameter determines where the controller gets its setpoint from. The default setpoint location is Remote. In Remote setpoint location mode the controller uses the signal from its analog input as the target setpoint. See the section on Setting the Flow Setpoint. The controller can also be put into Local setpoint location mode. In Local setpoint location mode the controller will ask for a Flow or Damper Position setpoint (depending on the selected control mode) to be entered using the up and down arrows on the controller's cover when in the Field Configuration Menu (see the Field Configuration menu structure). When the controller's toggle switch is moved back into run mode it will control the damper to the entered setpoint instead of the value sent to the analog input. Local setpoint mode should be used when the desired flow or position setpoint is constant.
- **Setpoint Input** - this parameter sets the type of analog signal that will be sent to the controller as the remote setpoint. The default selection is 0-10 VDC, but the controller can be configured to accept a 2-10 VDC signal.
- **Field Correction** – this parameter can be used to adjust the airflow calculation of the controller. The default value is 1.0. Changing this value will adjust the calculated flow proportionally. For example, setting the Field Correction factor to 0.95 will reduce the calculated flow values by 5%. Setting it to 1.05 will increase the calculated flow by 5%.
- **Air Density Correction** – this parameter adjusts the airflow calculation to account for changes in the dry bulb temperature of the air being measured and/or the elevation above sea level of the jobsite. The default value is 1.00, which corresponds to an air temperature of 70° F and an elevation of 0 ft. Table 1 shows the Air Density Correction as a function of air temperature and elevation.
- **Response Time** – this parameter determines how the controller responds to changes in the setpoint or system conditions. The controller has three available response times. It comes from the factory set to the fastest response time. If, because of system conditions, the controller is "hunting" without settling on a point one of the slower response times should be selected. The Medium response time should be tried first. If the controller is still not settling on a point the Slow setting should be used.
- **Control Deadband** – this parameter determines the range of acceptable values around the setpoint that the controller will attempt to achieve. The factory default Control Deadband is 25 fpm. As an example, with a 25 fpm deadband and a setpoint of 1,000 fpm the controller will adjust the damper's position until the real-time velocity is between 975 fpm and 1,025 fpm (note that fpm can be converted to cfm by multiplying by the AMD/AMS area). Larger deadbands will make it easier for the controller to reach an acceptable point, but may result in the real-time flow being further from the setpoint.
- **Override Out** – the controller has a voltage free non-grounded contact that can be used to override the normal operation of the controller. When the contact is open the controller functions normally. However, if the contact is closed the controller will drive the actuator to an override position. The override position is set to 100% open from the factory, but may be adjusted to any position between 0 and 100%.
- **Sensor Filter** – this parameter establishes the amount of averaging the controller performs on the pressure reading before it updates the airflow calculation. The factory default setting is 3 seconds. The value should not be adjusted below 3 seconds and should only be increased above 3 seconds if turbulence such as wind gusts result in sporadic airflow measurement readings. If the sensor filter is increased above 3 seconds one of the slower response time settings will likely need to be used to avoid the actuator hunting for the setpoint.

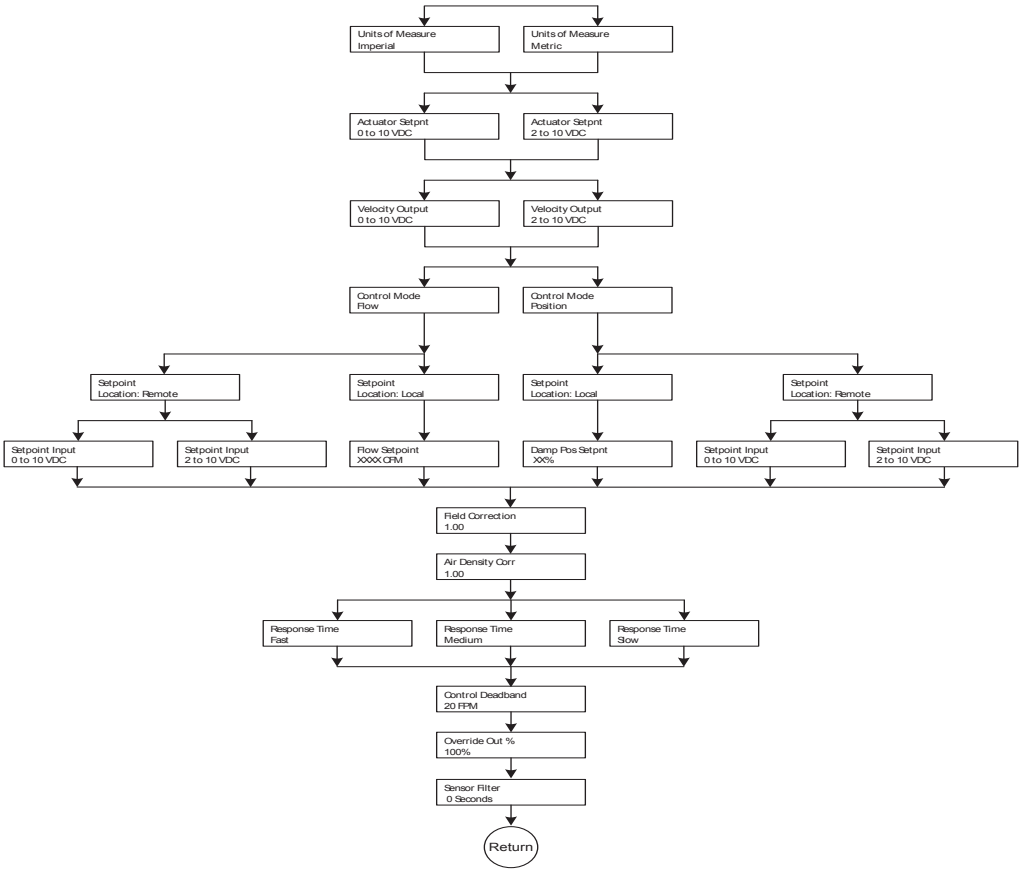


Figure 6- Field Configuration Menu Structure

Duct Air Temp	Air Density Correction Factors Elevation Dimensions in feet and (meters)																		
°F (C°)	0 (0)	500 (152.4)	1000 (304.8)	1500 (457.2)	2000 (609.6)	2500 (762)	3000 (914.4)	3500 (1066.8)	4000 (1219.2)	4500 (1371.6)	5000 (1524)	5500 (1676.4)	6000 (1828.8)	6500 (1981.2)	7000 (2133.6)	7500 (2286)	8000 (2438.4)	8500 (2590.8)	9000 (2743.2)
-40 (-40)	0.79	0.81	0.82	0.84	0.85	0.87	0.88	0.90	0.92	0.93	0.95	0.97	0.99	1.01	1.02	1.04	1.06	1.08	1.10
-20 (-29)	0.83	0.85	0.86	0.88	0.89	0.91	0.93	0.94	0.96	0.98	1	1.01	1.03	1.05	1.07	1.09	1.11	1.14	1.16
0 (-18)	0.87	0.88	0.9	0.92	0.93	0.95	0.97	0.99	1	1.02	1.04	1.06	1.08	1.10	1.12	1.14	1.16	1.19	1.21
20 (-7)	0.91	0.92	0.94	0.96	0.97	0.99	1.01	1.03	1.05	1.07	1.09	1.11	1.13	1.15	1.17	1.19	1.22	1.24	1.26
40 (4)	0.94	0.96	0.98	1	1.01	1.03	1.05	1.07	1.09	1.11	1.13	1.15	1.17	1.20	1.22	1.24	1.27	1.29	1.31
60 (15)	0.98	1	1.02	1.04	1.05	1.07	1.09	1.11	1.13	1.16	1.18	1.20	1.22	1.24	1.27	1.29	1.32	1.34	1.37
70 (21)	1	1.02	1.04	1.06	1.07	1.09	1.11	1.14	1.16	1.18	1.20	1.22	1.24	1.27	1.29	1.32	1.34	1.37	1.39
80 (27)	1.02	1.04	1.06	1.08	1.10	1.12	1.14	1.16	1.18	1.20	1.22	1.24	1.27	1.29	1.32	1.34	1.37	1.39	1.42
100 (38)	1.06	1.08	1.10	1.12	1.14	1.16	1.18	1.20	1.22	1.24	1.27	1.29	1.32	1.34	1.37	1.39	1.42	1.44	1.47
120 (49)	1.09	1.11	1.13	1.16	1.18	1.20	1.22	1.24	1.27	1.29	1.31	1.34	1.36	1.39	1.41	1.44	1.47	1.50	1.53
140 (60)	1.13	1.15	1.17	1.19	1.22	1.24	1.26	1.29	1.31	1.33	1.36	1.38	1.41	1.44	1.46	1.49	1.52	1.55	1.58
160 (71)	1.17	1.19	1.21	1.23	1.26	1.28	1.30	1.33	1.35	1.38	1.40	1.43	1.46	1.48	1.51	1.54	1.57	1.60	1.63
180 (82)	1.21	1.23	1.25	1.27	1.30	1.32	1.35	1.37	1.40	1.42	1.45	1.48	1.50	1.53	1.56	1.59	1.62	1.65	1.68
200 (93)	1.25	1.27	1.29	1.31	1.34	1.36	1.39	1.41	1.44	1.47	1.49	1.52	1.55	1.58	1.61	1.64	1.67	1.70	1.74

Table 1 - Air Density Correction Factor

Manual Control

Manual Control mode allows the user to directly change the percent the damper is open by using the up and down arrows on the controller's cover. This can be done by entering the top level menu, scrolling down to Manual Control, and pressing "Enter". You can leave Manual Control mode at any time by pressing the "Back" button or by putting the slider switch inside the controller back into the run position.

Factory Defaults

For trouble shooting purposes, it may be desirable to reset the controller's parameters back to the factory defaults. This can be done by entering the top level menu, scrolling down to "Factory Defaults" and pressing enter. You will see an option to "Restore Factory Defaults". Select Yes and then select Enter again when asked "Are You Sure?". Once this is done you will need to go through each parameter in both the factory and field configuration menus and select the appropriate value.

Diagnostic LED

The controller has a multicolor LED that is used to distinguish between operating modes and to indicate trouble conditions.

- **Solid Green** – Flow Control with Remote Setpoint (Control Mode = Flow; Setpoint Source = Remote; Request Velocity >= Minimum Velocity)
- **Blinking Green** – Flow Control with Local Setpoint (Control Mode = Flow; Setpoint Source = Local; Request Velocity >= Minimum Velocity)
- **Solid Blue** – Position Control with Remote Setpoint (Control Mode = Position Setpoint Source = Remote; Request Velocity >= Minimum Velocity)
- **Blinking Blue** – Position Control with Local Setpoint (Control Mode = Position Setpoint Source = Local; Request Velocity >= Minimum Velocity)
- **Solid Purple** – Parameter Editing or Manual Mode
- **Solid Pink** – Override activated
- **Blinking Yellow** – Low Velocity Setpoint. The LED will blink yellow when the requested velocity is greater than 20 fpm, but less than the minimum velocity parameter. This indicates that the user is sending a velocity request, but that it is under the defined minimum velocity.
- **Blinking Red** – No Velocity Setpoint. When in Remote Setpoint Source mode regardless of the control mode, if the velocity request is less than 20 fpm the LED should blink red.

Wiring the Controller

The basic wiring of the controller is shown below in **Figure 7**. The controller's three terminal blocks can be accessed by opening the cover of the enclosure.

Powering the Controller - The controller is powered by applying electrical power to the "Power In" terminal block. The controller can run off of 24 VAC +/- 20% 50/60 Hz or 24 VDC +/- 10%

Connecting the Pressure Transducer - The second terminal block is labeled "Remote Sensor" and is used to connect to the pressure transducer. The three terminals from the Remote Sensor block connect directly to the pressure transducer as shown in **Figure 6**. The controller supplies the transducer with its power and reads the pressure signal.

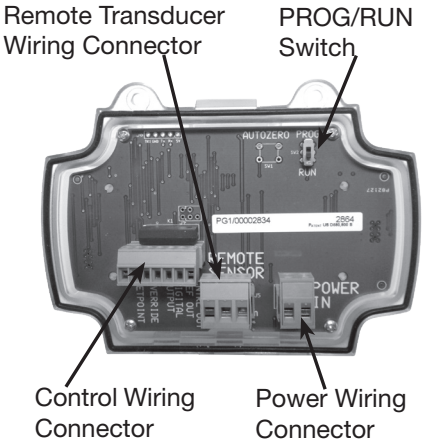
Connecting the Damper Actuator - The actuator can be powered either by the same power supply as the controller, as shown in **Figure 7**, or by running a separate power supply to terminals 4 and 5 of the factory supplied terminal block on the AMD/AMS. In addition, the "Control Out" from the controller (terminal 7) must be run to terminal 6 on the damper's terminal block.

Connecting the Flow (or position) Setpoint Signal - Connect the 0-10 VDC or 2-10 VDC flow (or position) setpoint to the controller terminals 1 and 3. The controller's terminal 1, labeled Remote Setpoint, is the positive terminal and the controller's terminal 3 is the common terminal.

Connecting to the Flow Output Signal - Connecting to controller terminals 6 and 3 allows the user to read the 0-10 VDC or 2-10 VDC flow output that is proportional to the cfm measured by the AMD/AMS. To convert the voltage signal to cfm see the section above on Airflow Output Signal.

Override Mode - The functionality of the override feature is described above in the Field Configuration section of this document. The override feature can be activated by closing the contacts of an external relay across terminals 2 and 3 (or by simply putting a jumper wire across them).

Vari-Green Constant Volume Controller Wiring Diagram



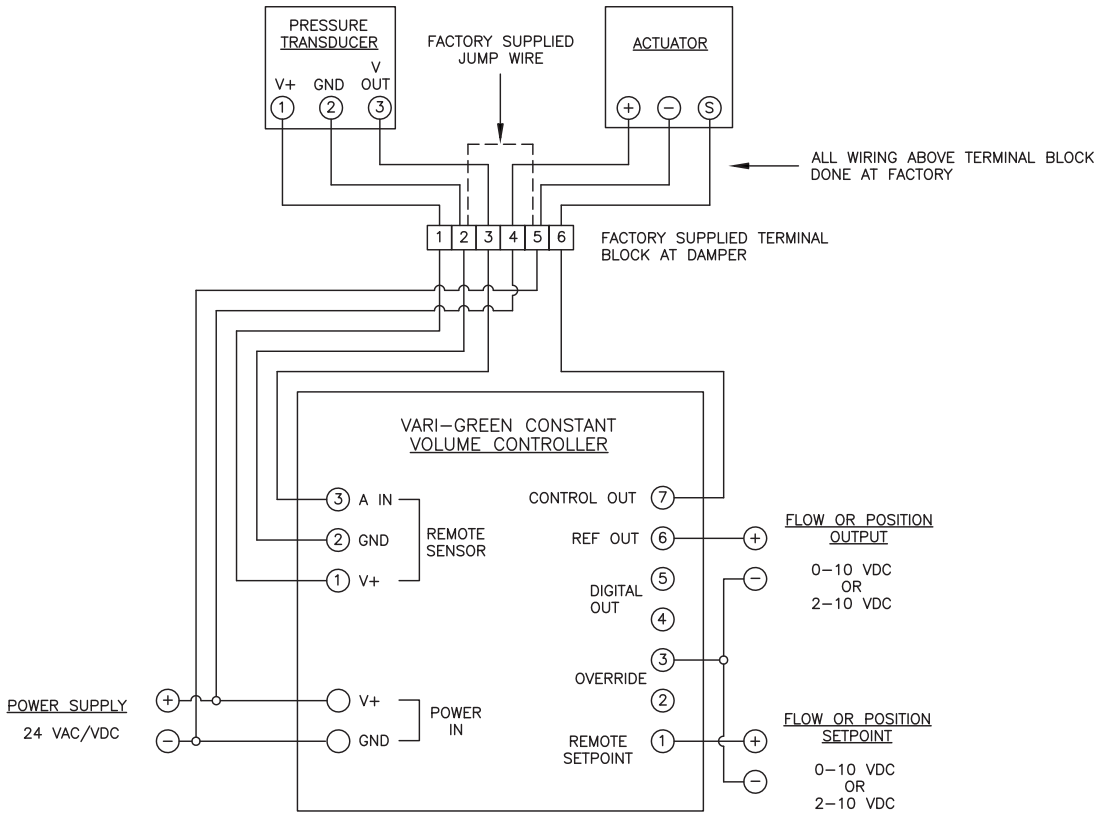


Figure 7 - Basic Wiring of Vari-Green Constant Volume Controller

Our Commitment

As a result of our commitment to continuous improvement, Greenheck reserves the right to change specifications without notice.

Product warranties can be found online at Greenheck.com, either on the specific product page or in the literature section of the website at Greenheck.com/Resources/Library/Literature.

GREENHECK
Building Value in Air.

Phone: 715.359.6171 • Fax: 715.355.2399 • Parts: 800.355.5354 • E-mail: gfcinfo@greenheck.com • Website: www.greenheck.com

